IN THE CLAIMS:

Kindly add new claim 42, which is included in the set of pending claims below.

1 1.   (Currently amended) A system for measuring tape pack radii, comprising:

2   a tape supply reel, said tape supply reel rotating as a tape leaves said tape supply

3 reel during a tape transfer process;

4   a tape take-up reel for receiving tape from said tape supply reel, said tape take-up

5 reel rotating to receive said tape during said tape transfer process;

6   a first angular position transducer to measure an a first angular position of said

7 tape supply reel;

8   a second angular position transducer to measure an a second angular position of

9 said tape take-up reel;

10   a third angular position transducer to measure an a third angular position of a me-

11 chanical device used to facilitate said tape transfer process, said mechanical device

12 changing said third angular position as in response to said tape leaves leaving said tape

13 supply reel and is being received by said tape take-up reel;

14   a processor having a Kalman filter, said Kalman filter responsive to one or both of

15 an said first and second angular position measurements by said first angular position

16 transducer and an angular position measurement by said second angular position trans-

17 ducer and also responsive to an said third angular position measurement by said third an-

18 gular position transducer, said Kalman filter including a mathematical model for to cal-

19 culating e an updated estimate of one or both of a supply radius of a tape pack on said tape

20 supply reel and a take-up radius of a tape pack on said tape take-up reel;

21   a servo-controller, responsive to one or both of said estimate of one or both of

22 said supply radius and said take-up radius, to control rotation of said tape supply reel and

23 said tape take-up reel.

1   2.   (Currently amended) The ~~apparatus~~ system as in claim 1, wherein said Kalman

2   filter further comprises:

3   a supply Kalman filter responsive to said first angular position ~~transducer~~ meas-

4   urement and said third angular position ~~transducer~~measurement;

5   a take-up Kalman filter responsive to said second angular position ~~transducer~~

6   measurement and said third angular position ~~transducer~~measurement.

1   4.   (Currently amended) The ~~apparatus~~ system as in claim 1, ~~further comprising:~~

2   wherein said mechanical device is a capstan, said tape contacting said capstan and said

3   capstan rotating as said tape transfers from said tape supply reel to said tape take-up reel.

1   5.   (Currently amended) The ~~apparatus~~ system as in claim 1, wherein said third an-

2   gular position transducer further comprises:

3   an encoder responsive to an angular position of a capstan.

1   6.   (Currently amended) The ~~apparatus~~ system as in claim 1 further comprising:

2   a tape length estimator responsive to said Kalman filter to determine the amount

3   of tape available for a record operation.

1   7.   (Currently amended) A system for measuring a length of tape available for a rec-

2   ord operation, comprising:

3   a tape supply reel, said tape supply reel rotating as a tape leaves said tape supply

4   reel during a tape transfer process;

5   a tape take-up reel for receiving tape from said tape supply reel, said tape take-up

6   reel rotating -to receive said tape during said tape transfer process;

7   a first ~~angular position~~ transducer to measure ~~an~~ a first angular position of said

8   tape supply reel;

9   a second ~~angular position~~ transducer to measure ~~an~~ a second angular position of

10 said tape take-up reel;

9

11   a third ~~angular position~~ transducer responsive to movement of said tape <u>as said</u>

12   <u>tape is transferred from said supply reel to said take-up reel</u>;

13   a processor having a Kalman filter, said Kalman filter responsive to one or both of

14   ~~an~~<u>said first and second</u> angular position measurement<u>s</u> ~~by said first angular position~~

15   ~~transducer and an angular position measurement by said second angular position trans-~~

16   ~~ducer~~ and also responsive to ~~an~~<u>a third</u> ~~angular position~~ measurement by said third ~~angu-~~

17   ~~lar position~~transducer, <u>said Kalman filter including a mathematical model for</u> ~~to~~ deter-

18   min<u>ing</u>~~e~~ an ~~updated~~ estimate of one or both of a supply radius of a tape pack on said tape

19   supply reel and a take-up radius of a tape pack on said tape take-up reel for calculating

20   said available length of tape; and

21   a servo-controller, responsive to <u>said estimate of</u> one or both of said supply radius

22   and said take-up radius, to control rotation of said tape supply reel and said tape take-up

23   reel.

1   8.   (Currently amended) A method for estimating a radius of a tape on a supply reel

2   and on a take-up reel, comprising:

3   measuring a first angular position of ~~a~~<u>said</u> ~~tape~~ supply reel;

4   measuring a second angular position of ~~a~~<u>said</u> ~~tape~~ take-up reel;

5   measuring a third angular position of a capstan that rotates to transfer the tape

6   between said tape supply and take-up reels; and,

7   estimating, by a processor ~~employing~~<u>that employs</u> a Kalman filter <u>including a</u>

8   <u>mathematical model,</u> a radius of a tape pack on said supply reel and a radius of a tape

9   pack on said take-up reel, in response to said first angular position of said tape supply

10   reel, said second angular position of said tape take-up reel, and said third angular position

11   of said capstan.

1   9.   (Currently amended) The method as in claim 8 wherein said estimating step by

2   said processor ~~having~~<u>employing</u> a Kalman filter further comprises:

3   ~~responding to~~<u>obtaining</u> an initial estimate of said radius of a tape pack on said

4   supply reel;

5   ~~responding to~~obtaining an initial estimate of a radius of <u>a</u> tape pack on said take-

6   up reel; and,

7   ~~responding to said first angular position measurement, said second angular posi-~~

8   ~~tion measurement, and said third angular position measurement to compute~~computing

9   said radius of said tape pack on said supply reel and said radius of -said tape pack on said

10   take-up reel <u>based on said initial estimate of said radius of a tape pack on said supply</u>

11   <u>reel, said initial estimate of a radius of a tape pack on said take-up reel, said first angular</u>

12   <u>position, said second angular position and said third angular position.</u>

1   10.   (Currently amended) The method of claim 8 further comprising:

2   ~~making~~ <u>measuring</u> said first angular ~~measurement~~ <u>position</u> at a first regular time

3   interval;

4   ~~making~~ <u>measuring</u> said second angular ~~measurement~~ <u>position</u> at a second regular

5   time interval;<u> and,</u>

6   ~~making~~ <u>measuring</u> said third angular ~~measurement~~ <u>position</u> at a third regular time

7   interval.

1   11.   (Original) The method of claim 10 further comprising:

2   choosing said first regular time interval, said second regular time interval and said

3   third regular time interval each to be approximately 20 milliseconds.

1   12.   (Currently amended) A method for estimating a length of <u>a</u> tape on ~~at least one~~<u>a</u>

2   tape supply reel <u>and on a tape take-up reel</u>, <u>the method</u> comprising:

3   measuring a first angular position of ~~a~~ <u>said</u> tape supply reel ~~of said at least one~~

4   ~~reel~~;

5   measuring a second angular position of ~~a~~ <u>said</u> tape take-up reel ~~of said at least one~~

6   ~~reel~~;

7   measuring a third angular position in response -to movement of said tape; and,

8   estimating, by a processor ~~employing~~ <u>that employs</u> a Kalman filter <u>including a</u>

9   <u>mathematical model,</u> said length of tape on said ~~at least one reel~~ <u>tape supply and tape</u>

10 take-up reels, in response to said first angular position of said tape supply reel, said sec-

11 ond angular position of said tape take-up reel, and said third angular position measured in

12 response to movement of said tape.

1 13.   (Currently amended) The ~~apparatus~~ system as in claim 1, wherein: ~~said first, sec-~~

2 ~~ond, and third angular position transducers further comprise:~~

3   said first angular position transducer comprises a first~~, second, and third~~ optical

4 encoder responsive to ~~the~~ said first angular position of the tape supply reel;~~,~~

5   said second angular position transducer comprises a second optical encoder re-

6 sponsive to said second angular position of the tape take-up reel; and~~, and~~

7   ~~the~~ said third angular position transducer~~, respectively~~ comprises a third optical

8 encoder responsive to said third angular position of the mechanical device.

1 14.   (Currently amended) A method for estimating a length of tape ~~on a~~ transferred

2 from a tape supply reel to a tape take-up reel, comprising:

3   measuring a first angular position of ~~a~~ said tape supply reel;

4   measuring a second angular position of ~~a~~ said tape take-up reel;

5   measuring a third angular position of a capstan engaging the tape as said tape is

6 transferred from said tape supply reel to said tape take-up reel; and,

7   estimating said length of tape by a processor employing a Kalman filter including

8 a mathematical model, said Kalman filter responsive to at least one of said first and sec-

9 ond angular positions ~~of said tape supply reel, said second angular position of said tape~~

10 ~~take-up reel,~~ and also responsive to said third angular position ~~of said capstan~~.

1 15.   (Currently amended) A method for estimating a length of a tape on ~~one or more~~ a

2 tape reels, comprising:

3   selecting said tape reel from one or more tape reels;

4   measuring a first angular position of ~~a tape supply reel of said one or more~~

5 ~~reels~~ said tape reel;

6   ~~measuring a second angular position of a tape take-up reel of said one or more~~

7   ~~reels;~~

8   measuring a ~~third~~ <u>second</u> angular position of a capstan engaging ~~the~~ <u>said</u> tape;

9   measuring a ~~fourth~~ <u>third</u> angular position of a tape tension arm; <u>and</u>

10   ~~selecting either said tape supply reel or said take-up reel as a selected reel; and,~~

11   estimating said length of <u>said</u> tape by a processor employing a Kalman filter <u>in-</u>

12   <u>cluding a mathematical model</u>, said Kalman filter responsive to said <u>measured first, sec-</u>

13   <u>ond and third</u> angular position<u>s</u> ~~of said selected reel, said third angular position of said~~

14   ~~capstan, and said fourth angular position of said tape tension arm~~.

1   16.   (Currently amended) The method of claim 14 comprising:

2   measuring a fourth angular position of a tape engaging member which causes a

3   change in ~~the~~ <u>a</u> tape path length as tape is unwound from and wound onto the <u>supply and</u>

4   <u>take-up reels,</u> respective<u>ly</u> ~~reel~~; and<u>,</u>

5   the step of estimating by a processor employing a Kalman filter includes said

6   Kalman filter being responsive to said fourth angular position of said tape engaging

7   member as well as the measured first, second, and third angular positions.

1   17.   (Currently amended) A method for estimating the amount of tape on a tape reel,

2   comprising:

3   measuring a first angular position of said tape reel;

4   measuring a second angular position of a cylindrical member engaging and rotat-

5   ing with the tape as the tape moves along a tape path;

6   measuring a third angular position of a tension arm engaging the tape between

7   said reel and said cylindrical member; and,

8   estimating how much tape is on said tape reel by a processor employing a Kalman

9   filter <u>including a mathematical model</u>, said Kalman filter responsive to said first angular

10   position of said tape reel, said second angular position of said cylindrical member, and

11   said third angular position of said tension arm.

1   18.   (Previously added) The method of claim 17 wherein the cylindrical member en-

2   gages the tape to cause the tape to follow the tape path.

1   19.   (Previously added) The method of claim 17 wherein the cylindrical member is a

2   capstan that engages the tape and upon rotation causes the tape to move along the tape

3   path.

1   20.   (Currently amended) A system for measuring how much tape is on a reel from

2   and to which tape is unwound and wound respectively during the rotation of the reel as

3   the tape is moved along a tape path, comprising:

4   a cylindrical member engaging the tape at a position along the tape path that es-

5   tablishes a tape path length from the reel, said cylindrical member engaging said tape,

6   said cylindrical member rotating as the tape is moved along the tape path;

7   a first angular position transducer for measuring a first angular position of said

8   reel as the tape is moved along the tape path;

9   a second angular position transducer for measuring a second angular position of

10   the cylindrical member as the tape is moved along the tape path; and

11   a processor including a Kalman filter responsive to the first and second angular

12   positions measured by the first and second angular position transducers, said Kalman fil-

13   ter including a mathematical model for calculating how much tape is on said reel.

1   21 .   (Previously added) The system as in claim 20 wherein the tape cylindrical mem-

2   ber engages the tape to cause this tape to follow the tape path.

1   22.   (Previously added) The system as in claim 20 wherein the tape cylindrical mem-

2   ber is a capstan that engages the tape and upon rotation causes this tape to move along the

3   tape path.

1   23.   (Previously added) The system as in claim 20 further comprising:

2   a second member engaging the tape which causes a change in the tape path length

3   from the reel to the position at which the cylindrical member engages the tape as the tape

4   is moved along the tape path;

5   a third angular position transducer for measuring a third angular position of the

6   second member as the tape is moved along the tape path; and

7   said processor calculating how much tape is on the reel in response to the third

8   angular position measured by the third angular position transducer as well as the meas-

9   ured first and second angular positions.

1   24.   (Previously added) The system of claim 23 wherein the second tape engaging

2   member is a tension arm mechanism that engages tape at a position along the tape path

3   between the reel and the cylindrical member.

1   25.   (Currently amended) A method for measuring how much tape is on a reel from

2   and to which tape is unwound and wound respectively during the rotation of the reel as

3   the tape is moved along a tape path, comprising:

4   measuring the amount of rotation by the reel as the tape is unwound from ~~and/~~or

5   wound onto the reel;

6   measuring the amount of movement of the tape along the tape path as the tape is

7   unwound from ~~and/~~or wound onto the reel, the movement of the tape measured at a posi-

8   tion along the tape path that establishes a tape path length from the reel; and,

9   calculating, by a processor that employs a Kalman filter <u>including a mathematical</u>

10   <u>model,</u> how much tape is on the reel in response to the measured amount of rotation by

11   the reel and the measured amount of movement of the tape.

1   26.   (Currently amended) The method of claim 25 further comprising:

2   measuring the amount of change in the tape path length as the tape is unwound

3   from ~~and/~~or wound onto the reel; and,

4   said step of calculating how much tape is on the reel is in response to the meas-

5   ured amount of change in the tape path length as well as the measured amounts of reel

6   rotation and tape movement.

1   27.   (Currently amended) The method of claim 25, further comprising:

2   a. ~~choosing a variable to be measured;~~combining said measured amount of rota-

3   tion by said reel and said measured amount of movement of the tape along the tape path

4   to derive a measured radius of tape on said reel;

5   b. selecting a minimum and maximum acceptable measurement value of said

6   ~~variable~~measured radius;

7   c. if said measured radius is less than the minimum acceptable value of said ra-

8   dius, then setting the value of the measured radius to the minimum acceptable measure-

9   ment value of said radius;

10   d. if said measured radius is greater than the maximum acceptable value of said

11   radius, then setting the value of the measured radius to the maximum acceptable meas-

12   urement value of said radius;

13   ~~c~~e. selecting a maximum acceptable variance ~~of~~corresponding to said ~~variable~~

14   measured radius;

15   ~~d~~f. ~~recording an individual measurement~~calculating a measured variance based on

16   said measured radius;

17   ~~e~~g. determining if said ~~individual measurement's~~measured variance is greater than

18   said maximum acceptable variance;

19   ~~f~~h. determining if a three sigma-interval around said ~~individual measurement~~

20   measured radius is not at least partially included within an interval from said minimum to

21   said maximum acceptable radius measurement values; and,

22   ~~g~~i. if the determinations in steps ~~e~~g OR ~~f~~h prove true, ignoring the ~~individual~~

23   ~~measurement~~measured radius and ~~basing~~calculating an estimate of how much tape is on

24   the reel based on one or more previous estimates of how much tape is on the reel~~the cur-~~

25   ~~rent Kalman filter estimate on other measurements and on previous Kalman filter esti-~~

26   ~~mates.~~

1   32.   (Currently amended) The ~~apparatus~~ system as in claim 1 wherein said third an-

2   gular position transducer further comprises:

3   an encoder responsive to an angular position of a supply reel tension arm.

1   33.   (Currently amended) The ~~apparatus~~ system as in claim 1 wherein said third an-

2   gular position transducer further comprises:

3   an encoder responsive to an angular position of a take-up reel tension arm.

1   34.   (Currently amended) A method for estimating a length of a tape on a reel, com-

2   prising:

3   a.   ~~choosing a variable to be measured, said variable related to estimating a~~

4   ~~length of tape on a reel;~~obtaining a measured radius of tape on said reel;

5   b.   selecting a minimum and maximum acceptable measurement value of said

6   ~~variable~~measured radius;

7   c.   if said measured radius is less than the minimum acceptable value of said

8   radius, then setting the value of the measured radius to the minimum acceptable meas-

9   urement value of said radius;

10   d.   if said measured radius is greater than the maximum acceptable value of

11   said radius, then setting the value of the measured radius to the maximum acceptable

12   measurement value of said radius;

13   ~~e~~e.   selecting a maximum acceptable variance ~~of~~corresponding to said ~~vari-~~

14   ~~able~~measured radius;

15   ~~d~~f.   calculating a measured variance based on said measured radius~~recording~~

16   ~~an individual measurement of said variable;~~

17   ~~e~~g.   determining if said ~~individual measurement's~~measured variance is greater

18   than said maximum acceptable variance;

19   ~~f~~h.   determining if a three sigma-interval around said ~~individual measure-~~

20   ~~ment~~measured radius is not at least partially included within an interval from said mini-

21   mum to said maximum acceptable radius measurement values; and,

22   i.____if the determinations in steps e-g OR f-h prove true, ignoring the ~~individual~~

23 ~~measurement~~measured radius and estimating said length of said tape on said reel based

24 on one or more previous estimates of said length of said tape on said reel~~basing the cur-~~

25 ~~rent Kalman filter estimate on other measurements and on previous Kalman filter esti-~~

26 ~~mates~~.

1   35.   (Currently amended) A method for estimating a length of tape on a reel, com-

2 prising:

3   a. ____choosing a variable to be measured, said variable related to estimating ~~a~~

4 said length of tape on ~~a~~ said reel;

5   ~~b. selecting a minimum and maximum acceptable measurement value of said~~

6 ~~variable;~~

7   e<u>b</u>. ___selecting a maximum acceptable variance ~~of~~corresponding to said vari-

8 able;

9   ~~d~~<u>c</u>.   ~~recording~~obtaining an individual measurement of said variable;

10   e<u>d</u>.   determining if said individual measurement's variance is greater than said

11 maximum acceptable variance; and,

12   e.____if the determination in step e-<u>d</u> proves true, ignoring the individual meas-

13 urement and basing ~~the~~ a current Kalman filter estimate of said length of tape on said reel

14 on other measurements and on previous Kalman filter estimates.

1   36.   (Currently amended) A method for estimating a length of tape on a reel, com-

2 prising:

3   a.   choosing a variable to be measured, said variable related to estimating ~~a~~

4 said length of tape on ~~a~~ said reel;

5   b.   selecting a minimum and maximum acceptable measurement value of said

6 variable;

7   ~~c.   selecting a maximum acceptable variance of said variable;~~

8   ~~d~~<u>c</u>.   ~~recording~~obtaining an individual measurement of said variable;

9   e~~c~~d.   determining if a three sigma-interval around said individual measurement

10   is not at least partially included within an interval from said minimum to said maximum

11   acceptable radius measurement values; and,

12   e.   if the determination in step e~~d~~ proves true, ignoring the individual meas-

13   urement and basing ~~the~~a current Kalman filter estimate of said length of tape on said reel

14   on other measurements and on previous Kalman filter estimates.

1   37.   (Currently amended) The method of ~~claim 34 or~~ claim 35 or claim 36 further

2   comprising:

3   choosing as said variable ~~an angular position of said reel~~a measured radius, said

4   measured radius being derived at least based on a measured angular position of a supply

5   tape reel.

1   38.   (Currently amended) The method of ~~claim 34 or~~ claim 35 or claim 36 further

2   comprising:

3   choosing as said variable ~~an angular position of a second reel upon which said~~

4   ~~tape is wound~~a measured radius, said measured radius being derived at least based on a

5   measured angular position of a take-up tape reel.

1   39.   (Currently amended) The method of ~~claim 34 or~~ claim 35 or claim 36 further

2   comprising:

3   choosing as said variable ~~an angular position of a transducer, said transducer re-~~

4   ~~sponsive to movement of said tape~~a measured radius, said measured radius being derived

5   at least based on a measured amount of said tape which is transferred between a supply

6   tape reel and a take-up tape reel.

1   40.   (Currently amended) The method of claim 39, ~~further comprising:~~wherein said

2   measured amount of said tape which is transferred between said supply tape reel and said

3   take-up tape reel is measured based on a

4   ~~choosing said transducer to~~ measured angular position of a capstan, said tape in contact

5   with said capstan, said capstan rotating as said tape moves.

1   41.   (Currently amended) The method of claim 39, ~~further comprising:~~wherein said

2   measured amount of said tape which is transferred between said supply tape reel and said

3   take-up tape reel is measured based on a

4   ~~choosing said transducer to~~ measured ~~an~~ angular position of a tension arm in contact

5   with said tape.

1   42. (New) A method for estimating a length of a tape on a tape reel, comprising:

2   measuring an angular position of said tape reel;

3   measuring a length of said tape which is unwound from or wound onto said tape

4   reel during a regular time interval; and,

5   estimating, by a processor that employs a Kalman filter including a mathematical

6   model, said length of said tape on said tape reel in response to said measured angular po-

7   sition of said tape reel and said measured length of said tape which is unwound from or

8   wound onto said tape reel during a regular time interval.